

Dreams, Paradigm Shifts and Reforms in Mathematics Education: Classification and Plan of Action

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The present paper is concerned with the classification of possible areas of change in mathematics education into dreams, paradigm shifts and reform in order to set up an appropriate plan of action to deal with each. Dreams include integration and non-formal teaching. Paradigm shifts include: developing creativity, interests of students, self education, changing methods of teaching and evaluation, considering complexity and the role of “teacher”, while reforms include paying more attention to application of mathematics, the use of technology, and educational activities, and concentrating on mathematical concepts and the “points of departure” in mathematics. A special section is devoted for the suggested plan of action in each of the classified areas of change. However, changing the mentality of the concerned people - especially teachers - is needed in all cases as well as consistency among all components of the educational system and curricula. The studied changes are applicable in almost all countries, may be in different manner and different time.

Introduction

The present paper is concerned with the classification of possible areas of change in mathematics education into dreams, paradigm shifts and reforms ⁽¹⁾ in order to set up an appropriate plan of action to deal with each. The major criterion of classification is the degree of applicability of these changes. Dreams seems to be in one stream - not applicable at the moment, while paradigm shifts are applicable under certain conditions and reforms - in the other stream- are ready to be applied after taking necessary decisions and procedures. However, the position of those changes is changeable according to many factors, with time and availability of encouraging environment to come first as major factors.

Classification of possible areas of change ⁽²⁾

Dreams

- 1- Teaching mathematics in integrated contexts to the extend to which it could be said that there is no mathematics education as such ⁽³⁾.
- 2- School materials will be presented in the form of integrated activities through knowledgeable projects.
- 3- There will be no “traditional” formal teaching of mathematics. Students will “theorize” for themselves.
- 4- Higher education, especially the study for the first degree, will follow the same pattern, with more direction to the field of study and research assignments (instead of projects).

Paradigm shifts

- 1- The major aims of teaching mathematics are to develop creativity, to make the study enjoyable and to prepare students to deal with future changes (both in knowledge and jobs).
- 2- The whole school system will be based upon multiple intelligences theory ⁽⁴⁾.
- 3- Adopting problem-solving and “research problems” as dominating methods of teaching mathematics.

- 4- Complexity is considered in all educational activities⁽⁵⁾. Emphasis must be given to “commons” among different systems to state assumptions underlying different formulas and the existence of different possible solutions.
- 5- Evaluation of students is mainly based on continuous and non-formal evaluation. Great attention will be given to self evaluation and discussion of student’s reports and “research work”.
- 6- The major job of a teacher is as facilitator.

Reforms

- 1- Studying applications of mathematics in other disciplines and in life, as an essential part of school mathematics.
- 2- Concentrating on conceptual bases with very little attention to computations, with the use of calculators and computers.
- 3- Intensive use of technology, with emphasis on data collection, building knowledge and self-learning.
- 4- Studying the history of mathematics, with particular emphasis on the “departure points” (the cultural historical approach).
- 5- Paying more attention to school activities relevant to mathematics education.

Suggested plan of action

- 1- Starting with reforms and attempting some “paradigm shifts”.
- 2- As for reforms:
 - a) Plan to implement reforms, e.g. prepare necessary equipments, conducting in-service teacher education programmes, changing current pre-service teacher education programmes- when needed ... etc.
 - b) Studying past experiences and considering lessons from them. For instance, some good applications of mathematics are included in some text books⁽⁶⁾, but ignored by teachers, may be because they are not included in examinations.
 - c) Participation of teachers in all procedures leading to reform.
- 3- As for adopting paradigm shifts, the following procedures can be taken:
 - a) Convincing teachers and the public opinion - in general, with the value of these paradigm shifts and explaining the way to implement them.
 - b) Consistency of all components of the whole educational system as well as those of mathematics curricula including aims, content, methods of teaching, using technology, educational activities and evaluation.
 - c) Priorities for change are for: text-books, teaching methods, means and tools of evaluation and school activities.
- 4- As regards dreams, many steps can be taken, such as:
 - a) Paving the way to change the mentality of planners, text-book writers, administrators, teachers, parents and students for specific changes, particularly integration.

- b) Changing the whole system of both pre-service and in-service teacher education.
- c) Encouraging attempts to integrate branches within a subject and among some subjects.

A Final Word

The author would like to confirm the following:

- a) The previous classification is flexible and some of its items are interacted and interrelated.
- b) Many of these previous elements- especially reforms- are applied in some countries.
- c) The mentioned areas of change are applicable in almost all countries, may be in different manner and different time.

Notes

- (1) Although the author can not deal with all the terms involved within the available space, he would like to explain that he means by paradigm shift “a revolution due to a fundamental change in our world view which changes even the way reality is perceived and understand”.
See: Kuhn, Thomas S. (1972). **The Structure of Scientific Revolutions** London: Phoenix.
Quoted from: Rugerson, Alan (2010). “The DQME Project as Part of a World-Wide Paradigm Shift In Mathematics Education”, **A Background Paper Presented to the DQME3 Meeting**, June 29 - July 2, 2010, Ciechocinek (Poland).
- (2) For sources of these areas of change, the writer reviewed his papers which were presented to ME21 Conferences (1999, 2000, 2003, 2004 and 2005), in addition to the following paper:
Mina, Fayez M. (2010). “Some Suggested Alternatives to Activate Some New Trends in Mathematics Education”, **A Paper Presented to the Conference of the Egyptian Society of Mathematics Education**, Cairo, 3rd August, 2010. (In Arabic).
- (3) It seems that the only attempt to integrate mathematics with life is done by MISP in rather primary education. See:
Gamble, Andy and Rogerson, Alan (1997). **Making Links**. New Zealand: User Friendly Resource Enterprises.
Rogerson, Alan (1995). **Playing Cards**, and **Building Bridges**. (The same publisher).
Rogerson, Alan (1998). **Divine Designs**; and **Patterns & Tiling** (The same publisher).
Rogerson, Alan (1999). **Maths? It's magic**: (The same publisher).
- (4) See:
Gardner, Howard (1983). **Frames of Mind: The Theory of Multiple Intelligences**. New York: Basic Books.
(1999). **Intelligence Reframed; Multiple Intelligence for the 21st Century**: New York: Basic Books.
- (5) Complexity can be described in terms of the following terms:
 - 1- There is no more simple and absolute laws controlling motion and globe.
 - 2- Unity of human knowledge.
 - 3- Research is no more neutral.
 - 4- Thought is no more controlled by logic, and knowledge is no more certain.
 - 5- It is suggested that the main goal of science is to understand reality with the intention to influence and change it.
 - 6- Cohesion of knowledge and its technological applications.
 - 7- The development in technologies of communication, measurement and its units and scientific calculations.
 See:

- Mina, Fayez M. (2003). **Issues in Curricula of Education**. Cairo the Anglo-Egyptian Bookshop, pp. 23 - 26. (In Arabic).
- (6) For Example: See the series of mathematics text-books **MATH POWER™** from 7th to 12th Grades, published by McGraw-Hill Ryerson Limited in Canada.

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